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Reliability Based Analysis of Multi-Lane Reinforced Concrete Slab Bridges

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Abstract : Empirical expressions for estimating the wheel load distribution and live-load bending moment are typically specified in highway bridge codes such as the AASHTO procedures. The purpose of this paper is to analyze the reliability levels that are inherent in reinforced concrete slab bridges that are designed based on the simplified empirical live load equations in the AASHTO LRFD procedures. To achieve this objective, bridges with multi-lanes (three and four lanes) and different spans are modeled using finite-element analysis (FEA) subjected to HS20 truck loading, tandem loading, and standard lane loading per AASHTO LRFD procedures. The FEA results are compared with the AASHTO LRFD moments in order to quantify the biases that might result from the simplifying assumptions adopted in AASHTO. A reliability analysis is conducted to quantify the reliability index for bridges designed using AASHTO procedures. To reach a consistent level of safety for three- and four-lane bridges, following a previous study restricted to one- and two-lane bridges, the live load factor in the design equation proposed by AASHTO LRFD will be assessed and revised if needed by alternating the live load factor for these lanes. The results will provide structural engineers with more consistent provisions to design concrete slab bridges or evaluate the load-carrying capacity of existing bridges.

Keywords : reliability analysis of concrete bridges, finite element modeling, reliability analysis, reinforced concrete bridge design, load carrying capacity
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